

Leviat®



HALFEN Adjustable Cantilever
REVOLUTION IN TUNNEL PIPE SUPPORT



HALFEN Adjustable Cantilever

The advantages at a glance

The HALFEN Adjustable Cantilever combines the established high load bearing of the medium duty system with much faster installation. Specifically designed for tunnels or other areas with a curved or inclined substrate. It is not necessary to know the cantilever angle at the time of design.



ONE PART FOR ALL LOCATIONS, DRAMATICALLY REDUCED COMPLEXITY

- > suitable for pipe clamps, shoes and cable trays
- > can be used for laid or suspended pipes
- > takes up site tolerance. Cope with changes due to site conditions

NO CUSTOM CANTILEVERS REQUIRED, NO ANGLES TO MEASURE

- > simplified design
- > no risk of custom cantilevers not fitting
- > rapid delivery of stock item = no custom fabrication lead time

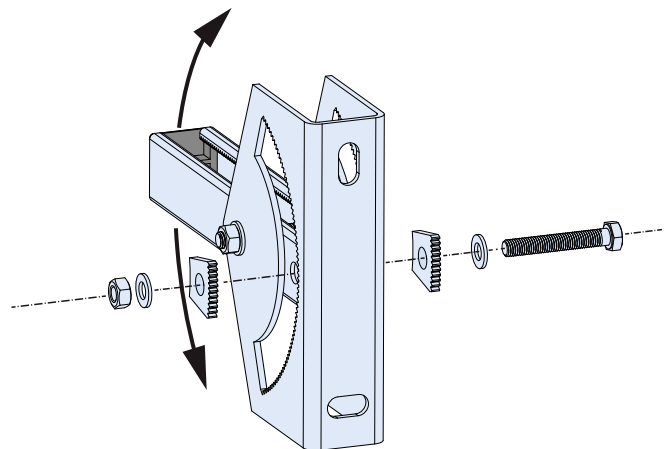
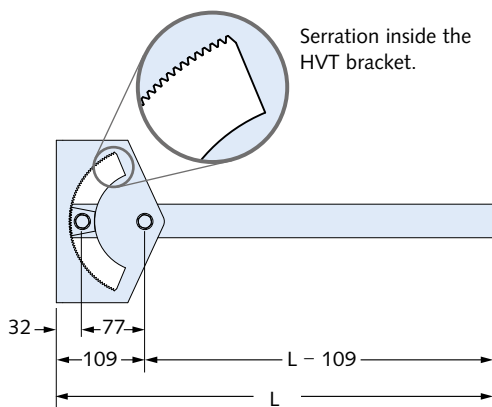
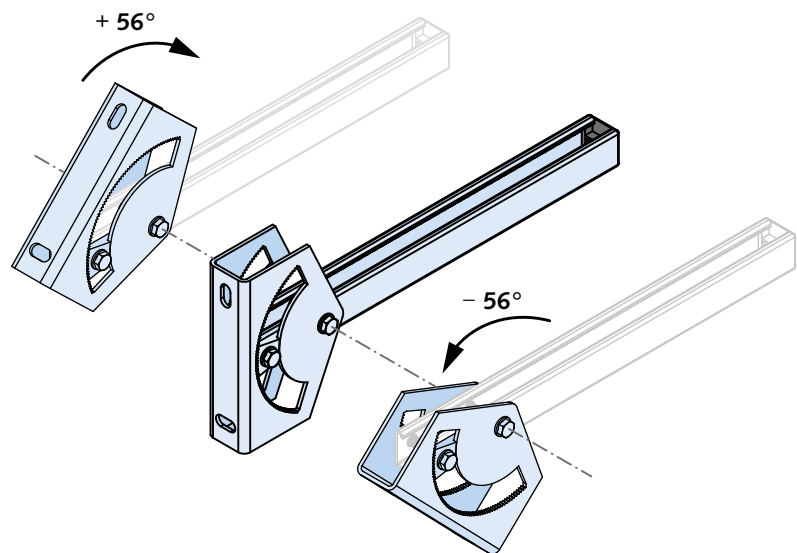


Introduction

The KON 41/V cantilever is freely adjustable from an angle of -56° to $+56^\circ$, and can be fixed to curved cast-in channel or surface-mounted framing channel or directly to the tunnel wall – including curved or inclined surfaces.

KON 41/V is made without welding, and is composed of a HALFEN Framing channel 41/41 cantilever arm and an adjustable HVT rear bracket.

The HVT rear bracket may also be used separately as a fixed support connection element in the HALFEN 41 Framing Channel System to restrain the rotation of a beam, unlike hinge connection elements.



The cantilever is available in three standard lengths. Custom lengths are also available.

The KON 41/V cantilever is easily set to the correct angle by loosening the serration plates. The bracket is set to the required angle, then the assembly is simply re-tightened.

Tried and tested – HALFEN Cast-in or Framing channel with HALFEN Bolts.
The ideal team for fastening in any environment.

For cast-in channels please refer to our catalogue "Technical Product Information HALFEN Cast-in channel".



HALFEN Adjustable Cantilever

KON 41/V

KON 41/V Product overview			
	Order no.	Item name	Item description
Sets - Assembled			
	0310.300-00001	KON 41/ V FV L=245 mm Adjustable Cantilever. complete, assembled.	Complete set. Fully assembled.
	0310.300-00002	KON 41/ V FV L=345 mm Adjustable Cantilever. complete, assembled.	Complete set. Fully assembled.
	0310.300-00003	KON 41/ V FV L=495 mm Adjustable Cantilever. complete, assembled.	Complete set. Fully assembled.
Components - for assembly			
	0310.310-00001	KON 41/ V- FV Rear bracket set of Adjustable Cantilever - with toothed plates and assembly bolts.	Requires arm for assembly.
	0310.320-00001	KON 41/ V-FV 245 mm arm only of Adjustable Cantilever	Arm only. Requires rear bracket set for assembly.
	0310.320-00002	KON 41/ V-FV 345 mm arm only of Adjustable Cantilever	Arm only. Requires rear bracket set for assembly.
	0310.320-00003	KON 41/ V-FV 495 mm arm only of Adjustable Cantilever	Arm only. Requires rear bracket set for assembly.
Spares			
	0310.330-00001	KON 41/V- FV spare toothed plate for adjustable cantilever	FV Toothed plate. Single spare, if required
Components and sets in stainless steel (A4) are available on request			

FV = hot-dip galvanized
A4 = stainless steel

* Note – order end caps separately, if required

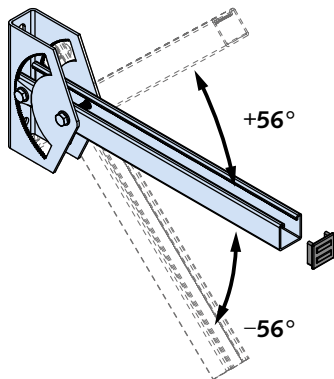
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KON 41/V

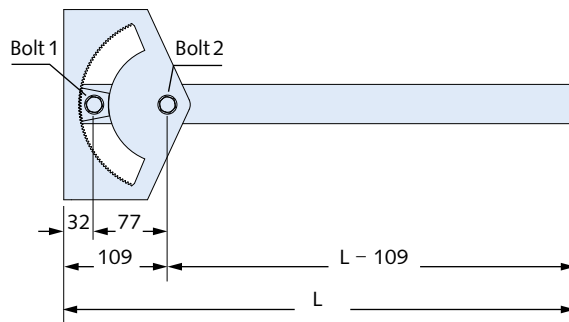
KON 41/V

The KON 41/V is the latest addition to the family of adjustable fixing products, providing the designer with elegant, load-tested solutions, while also giving the contractor a rapid and reliable install, which allows for site tolerances.

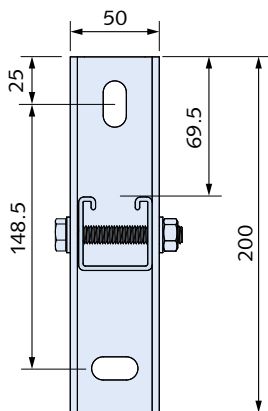
Design example → see page 8.



Maximum allowable and design forces					
Length L	Load				
[mm]	F [kN]	F_1	F_2	F_3	F_4
257	allow. load	5.55	2.89	2.77	1.85
	F_{Rd}	7.76	4.04	3.88	2.59
357	allow. load	3.44	1.72	1.72	1.15
	F_{Rd}	4.82	2.41	2.41	1.61
507	allow. load	2.15	1.07	1.07	0.72
	F_{Rd}	3.00	1.50	1.50	1.00



Cantilever disposition [mm]



Connector reaction forces for the maximum allowable and design forces					
Length L	Load				
[mm]	F [kN]	F_1	F_2	F_3	F_4
257	allow. load F_Z	6.83	4.99	6.83	6.83
	$F_{Z,Rd}$	9.57	6.99	9.57	9.57
	allow. load F_Q	5.55	2.89	5.55	5.55
	$F_{Q,Rd}$	7.76	4.04	7.76	7.76
357	allow. load F_Z	5.40	4.14	5.40	5.40
	$F_{Z,Rd}$	7.56	5.79	7.56	7.56
	allow. load F_Q	3.44	1.72	3.44	3.44
	$F_{Q,Rd}$	4.82	2.41	4.82	4.82
507	allow. load F_Z	4.45	3.66	4.45	4.45
	$F_{Z,Rd}$	6.23	5.13	6.23	6.23
	allow. load F_Q	2.15	1.07	2.15	2.15
	$F_{Q,Rd}$	3.00	1.50	3.00	3.00

HALFEN Adjustable Cantilever

KON 41/V Calculation Example

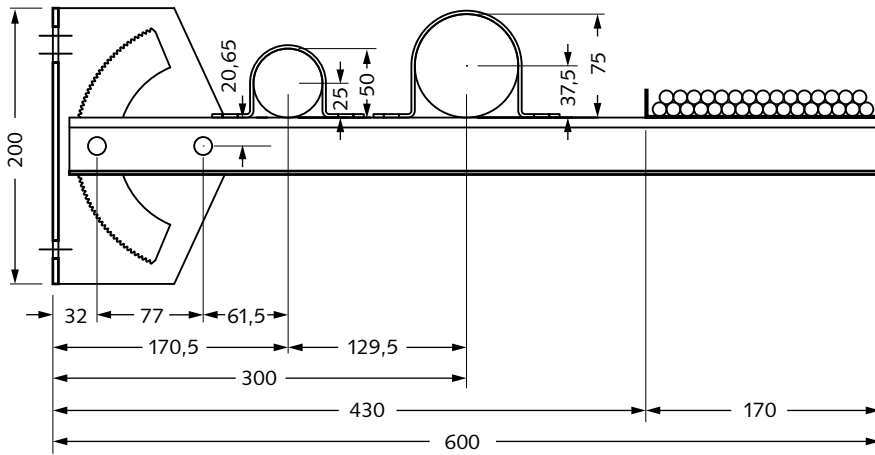
Calculation of the adjustable cantilever KON 41/V is based on the static calculation models as shown in the figures. The example is based on a cantilever with two mounted pipes of different diameter and a cable tray. The example is calculated with design values.

Loads:

$$\begin{aligned}
 F_{Z,1} &= 0.95 \text{ kN} \\
 F_{X,1} &= 0.10 \text{ kN} \\
 F_{Z,2} &= 1.90 \text{ kN} \\
 F_{X,2} &= 0.20 \text{ kN} \\
 q_z &= 1.10 \text{ kN/m}
 \end{aligned}$$

Design loads:

$$\begin{aligned}
 F_{Z,1,d} &= 1.4 \cdot F_{Z,1} = 1.33 \text{ kN} \\
 F_{X,1,d} &= 1.4 \cdot F_{X,1} = 0.14 \text{ kN} \\
 M_{Y,1,d} &= 2.065 \cdot F_{X,1,d} = 0.14 \text{ kNcm} \\
 F_{Z,2,d} &= 1.4 \cdot F_{Z,2} = 2.66 \text{ kN} \\
 F_{X,2,d} &= 1.4 \cdot F_{X,2} = 0.8 \text{ kN} \\
 M_{Y,2,d} &= 2.065 \cdot F_{X,2,d} = 0.58 \text{ kNcm} \\
 q_{z,d} &= 1.4 \cdot q_z = 1.54 \text{ kN/m}
 \end{aligned}$$



Calculation model 1 for design of:

HZM 41/41 or HM 41/41 profile:

shear forces at infinite distance to bolt 2 from both sides

$$\begin{aligned}
 V_{Z,Ed}^L &\leq V_{Z,Rd} \\
 V_{Z,Ed}^R &\leq V_{Z,Rd}
 \end{aligned}$$

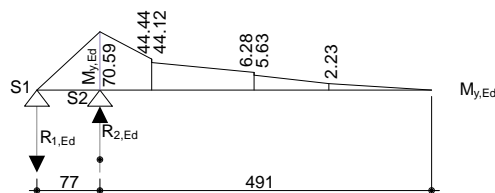
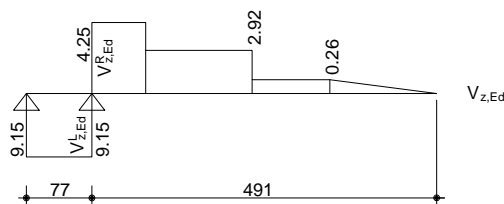
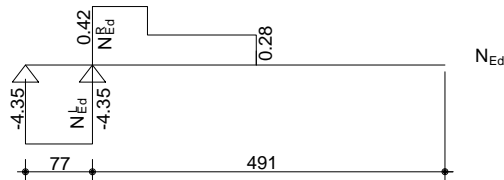
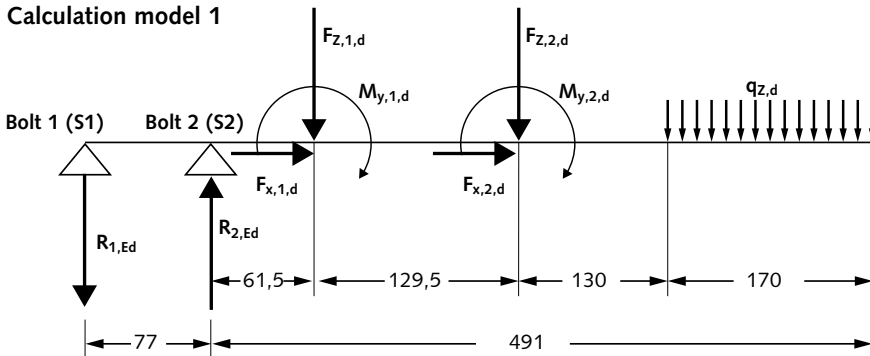
bending moment above bolt 2, considering shear force on both sides

$$\begin{aligned}
 M_{Y,Ed} &\leq M_{Y,Rd} \text{ (with } V_{Z,Ed}^L \text{) } \rho \text{ if required} \\
 M_{Y,Ed} &\leq M_{Y,Rd} \text{ (with } V_{Z,Ed}^R \text{) } \rho \text{ if required}
 \end{aligned}$$

normal force on both sides of bolt 2

$$\begin{aligned}
 N_{Ed}^L &\leq N_{Rd} \text{ (} \rho \text{ if required)} \\
 N_{Ed}^R &\leq N_{Rd} \text{ (} \rho \text{ if required)}
 \end{aligned}$$

Calculation model 1



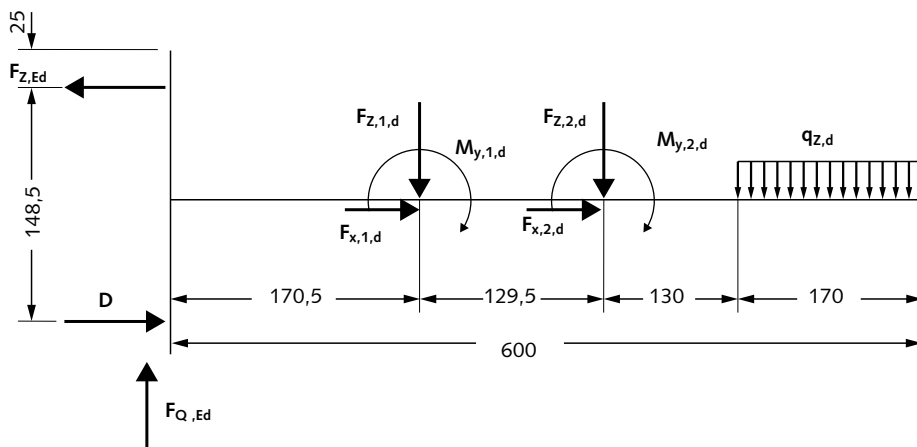
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KON 41/V

HZM or HM 41/41												
Section properties	f_y [N/mm ²]	τ [N/mm ²]	A [cm ²]	Z _c [cm]	I _y [cm ⁴]	I _z [cm ⁴]	Z _p [cm]	W _{pl} [cm ³]	N [kN]	V _Z [kN]	M _Y [kNcm]	Deformation
	235.00	135.68	2.688	1.725	7.130	6.887	0.969	3.946	63.16	11.98	69.67	elastic
									63.16	17.08	92.73	plastic
f_y : material yield strength τ : material shear strength A: section area Z_c : ordinate of elastic centroid I_y, I_z : bending moment of inertia				Z_p : ordinate of plastic centroid W_{pl} : plastic moment resistance el: elastic section forces $N_{el}; V_{y,el}; M_{y,el}$ pl: plastic section forces $N_{pl}; V_{y,pl}; M_{y,pl}$								

i We provide technical support for planning and calculating of all assembly products. Please refer to your local sales company. Contact information can be found at www.halfen.com

Calculation model 2



Calculation model 2 for calculation of connector forces:

$$F_{Z,Ed} \leq F_{Z,Rd}$$

$$F_{Q,Ed} \leq F_{Q,Rd}$$

Connector forces				
	Allowable forces		Design forces	
	Allowable R ₂ [kN]	Allowable F _Z [kN]	R _{2,d} [kN]	F _{Z,d} [kN]
	12.0	10.7	16.8	15.0

The values are adopted from the tables "maximum forces" and "connector reaction forces" normalization according f_y .

HVT Connector:

According to the first design criteria the following conditions must be verified:

$$R_{2,Ed} \leq R_{2,d} \text{ (for design loads)}$$

$$R_{2,Ed} \leq R_{2,allow.} \text{ (for allowable loads)}$$

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KON 41/V Calculation Example

Example:

From calculation model 2 the connector force $F_{z,Ed}$ can be calculated

Connector force

$$\sum M^+ = q_{z,d} \cdot 0.17 \cdot 51.5 + F_{z,2,d} \cdot 30 + M_{y,2,d} + F_{z,1,d} \cdot 17.05 + M_{y,1,d}$$

$$F_{z,Ed} = \frac{1}{14.85} \cdot \sum M^+ - F_{x,1,d} - F_{x,2,d}$$

$$F_{z,Ed} = 7.45 \text{ kN}$$

Design values for KON 41/V-FV

see table „Section properties“

$$M_{y,Rd} = \frac{M_{y,pl}}{\gamma_m} = \frac{92.73}{1.1} = 84.30 \text{ kN}$$

$$V_{z,Rd} = \frac{V_{z,pl}}{\gamma_m} = \frac{17.08}{1.1} = 15.52 \text{ kN}$$

$$N_{Rd} = \frac{N_{pl}}{\gamma_m} = \frac{63.16}{1.1} = 57.42 \text{ kN}$$

$$R_{2,d} = 16.8 \text{ kN}$$

$$F_{z,d} = 15.0 \text{ kN}$$

Proof of cantilever profile HZM 41/41 left from support S2

$$\frac{V_{z,Ed}^L}{V_{z,Rd}} = \frac{9.15}{15.52} = 0.59 \text{ kN} < 1.0 \quad \checkmark$$

$$V_{z,Ed}^L > 0.5 \cdot V_{z,Rd} \Rightarrow \rho = \left(2 \cdot \frac{V_{z,Ed}^L}{V_{z,Rd}} - 1 \right)^2 = 0.0321 \quad \checkmark$$

$$\frac{M_{y,Ed}}{(1-\rho) \cdot M_{y,Rd}} = \frac{70.59}{(1-0.0321) \cdot 84.3} = 0.865 \text{ kN} < 1.0 \quad \checkmark$$

$$\frac{N_{Ed}^L}{(1-\rho) \cdot N_{Rd}} = \frac{4.35}{(1-0.0321) \cdot 57.42} = 0.078 \text{ kN} < 1.0 \quad \checkmark$$

$$\frac{M_{y,Ed}}{(1-\rho) \cdot M_{y,Rd}} + \frac{N_{Ed}^L}{(1-\rho) \cdot N_{Rd}} = 0.943 \text{ kN} < 1.0 \quad \checkmark$$

Proof of cantilever profile HZM 41/41 right from support S2

$$\frac{V_{z,Ed}^R}{V_{z,Rd}} = \frac{4.25}{15.52} = 0.27 \text{ kN} < 1.0 \quad \checkmark$$

$$V_{z,Ed}^R < 0.5 \cdot V_{z,Rd} \Rightarrow \rho = 0$$

$$\frac{M_{y,Ed}}{M_{y,Rd}} = \frac{70.59}{84.3} = 0.837 \text{ kN} < 1.0 \quad \checkmark$$

$$\frac{N_{Ed}^R}{N_{Rd}} = \frac{0.42}{57.42} = 0.007 \text{ kN} < 1.0 \quad \checkmark$$

$$\frac{M_{y,Ed}}{(1-\rho) \cdot M_{y,Rd}} + \frac{N_{Ed}^R}{(1-\rho) \cdot N_{Rd}} = 0.844 \text{ kN} < 1.0 \quad \checkmark$$

All design criteria are fulfilled by the cantilever profile HZM 41/41

Proof of the HVT 41/V-VK-FV connector

see table „Connector forces“

$$\frac{R_{2,Ed}}{R_{2,d}} = \frac{13.4}{16.8} = 0.79 \text{ kN} < 1.0 \quad \checkmark$$

$$\frac{F_{x,Ed}}{F_{x,d}} = \frac{7.45}{15.0} = 0.50 \text{ kN} < 1.0 \quad \checkmark$$

All design criteria are fulfilled by the connector

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Please contact Leviat for more information on these products. Full contact details are available online at Leviat.com.